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NOMENCLATORIAL CHANGES IN ELYMUS WITH A KEY TO THE CALIFORNIAN SPECIES

FRANK W. GOULD

In the preparation of a systematic treatment of the genus *Elymus* and the related *Agropyron*, *Sitanion*, and *Hystrix* groups for the "Manual of California Grasses" which Dr. Alan A. Beetle is preparing, the writer has been compelled by a considerable amount of evidence to view this complex of the Hordeae as a single genus. Previously proposed nomenclatorial combinations show that in the past other systematists have shared this concept at least partially. Admittedly there is still much to be learned concerning specific and subspecific relationships, but the evidence at hand indicates that the groups of species involved cannot be segregated satisfactorily on a generic plane. It is probable that further submergence of genera in the tribe Hordeae will result from current investigations, especially in the fields of cytogenetics and plant breeding. Fertile hybrid *Triticum* × *Agropyron* generations are reported by Veruschkine (1935) and Tzitzin (1936).

Linnaeus recognized five genera in the Hordeae complex, in the following order: *Lolium*, *Elymus*, *Secale*, *Hordeum*, and *Triticum*. He referred the two known species of *Agropyron* to *Triticum*, the one known species of *Hystrix* to *Elymus*, and indicated no disposition of the *Sitanion* group. Benthams and Hooker (1883) listed twelve genera in the Hordeae, treating *Agropyron*, *Triticum*, *Elymus*, and *Asperella* (*Hystrix*) as separate genera and including *Sitanion* as a section of *Elymus*. In North American grass treatments, Beal (1896), and Hitchcock (1935), follow essentially the Benthams and Hooker classification, but Hitchcock recognizes *Sitanion* as a genus distinct from *Elymus*.

Classically, *Elymus* and *Agropyron* are distinguished on the basis of the number of spikelets at each node of the rachis, the

former with two or more spikelets per node and the latter with one. This results in the rather arbitrary separation of species that are obviously closely related, as in the *Elymus triticoides*, *E. cinereus*, *E. condensatus*, *E. salina*, *Agropyron Smithii*, *A. arenicola* group, and the *Elymus glaucus*, *Agropyron subsecundum*, *A. pauciflorum* complex. The weakness of this basis for distinction is shown also by the following series of *Elymus* species in which the characteristic number of spikelets per node is: *E. salina*, one spikelet at a node; *E. triticoides* and *E. glaucus* two spikelets at a node but in forms of both species only one spikelet at a node; *E. cinereus* three spikelets at a node; *E. condensatus* eight or more spikelets at a node, counting those on pedicels.

It has been noted that in *Elymus* the florets are oriented more-or-less dorso-ventrally to the rachis while in *Agropyron* they are lateral. This tendency is recognized readily in some species but is not uniformly evident throughout the two groups. In some spikes of *E. triticoides* both conditions can be observed.

The type species of *Agropyron*, *A. triticeum* Gaertn., is an annual, very unlike the American agropyrons, all of which are perennial, and more similar to species of *Triticum*. This and the annual *Elymus caput-medusae* L., both sparingly introduced into North America from Europe, probably should be excluded from the genus *Elymus* as here interpreted.

Elymus and *Sitanion* probably have been treated more generally as sections of one genus than as separate genera. When retained as distinct they are separated on the basis of the readily disarticulating rachis and the usually narrow, setaceous glumes of the latter. If this distinction were followed rigidly, *Elymus aristatus*, as known in California, would appear more *Sitanion*-like than the classically recognized species *Sitanion Hansenii*.

Hystrix, a genus of about four species, has been split off from *Elymus* primarily on the basis of glume reduction, one or both being completely lacking in some cases. Plants of the North American species are very similar to species of *Elymus*, especially *E. interruptus* which also has irregularly reduced glumes.

Stebbins, Valencia, and Valencia in their recent papers on artificial and natural hybrids in the *Hordeae* (1946) present numerous points in agreement with the writer's independent conclusions. They give cytological evidence for assuming that *Elymus glaucus* and *Sitanion Hystrix* are even more closely related than some species of *Elymus* as previously delimited. They report the occurrence of *Elymus-Sitanion* and *Elymus-Agropyron* hybrids in nature and describe artificially produced *Sitanion-Agropyron* hybrids. Evidence is presented for the belief that all plants that can be classified as *Sitanion Hansenii* are sterile F_1 hybrids between *Elymus glaucus* and either *Sitanion Hystrix* or *Sitanion jubatum*, and that *Agropyron Saundersii* probably is composed of a series of F_1 hybrids between *Agropyron pauciflorum* and *Sitanion Hystrix* or

Sitanion jubatum. Reference is made to a colony of hybrid *Elymus glaucus* \times *Agropyron pauciflorum* plants growing with the parent species near the Carnegie Institution experimental garden at Mather, Tuolumne County, California. This hybrid is discussed further by Hartung (1946).

The writer has noted an *Elymus* in the Sierra Ancha Mountains, Gila County, Arizona, which is morphologically intermediate between *Elymus glaucus* and *Agropyron subsecundum*. Plants of this type are abundant in the oak association at 5500 feet elevation, and no other forms of these two species occur in the vicinity.

ELYMUS L. Species Pl. 83. 1753. *Agropyron* Gaertn. Nov. Comm. Petrop. 14: 539. 1770. *Asperella* Willd. Roem. and Ust., Mag. Bot. 7: 5. 1790. *Hystrix* Moench. Meth. Pl. 295. 1794. *Sitanion* Raf. Journ. Phys. 89: 103. 1819. *Clinelymus* Griseb. Ledebour, Fl. Ross. 4: 330. 1853.

Annuals or perennials, many rhizomatous; blades linear or lanceolate, flat or involute, frequently glaucous, glabrous or variously pubescent; inflorescence basically spicate with 1 to 3 or occasionally 4 to 6 spikelets at a node, when more than 2 at one node one or more spikelets often short-pedicelled, in *E. condensatus* the inflorescence is a dense panicle; spikes disarticulating in the rachis or rachilla or both; glumes mostly subequal, reduced or absent in a few species, broadly lanceolate to attenuate or subulate, awnless, with a single principal awn, or with 2 to 4 awns or aristate teeth; lemmas mostly lanceolate, rounded on back, obtuse, acute, or aristate, usually inconspicuously nerved except near the apex; paleas mostly obtuse or truncate, about as long as and somewhat infolded by the lemmas.

Type species, *Elymus sibiricus* L. Species Pl. 83. 1753. (Concerning choice of type species see Hitchcock, 1936.)

KEY TO THE CALIFORNIAN SPECIES OF ELYMUS

A. Lemmas awned, the awns mostly 1 to 3 cm. long; plants typically without rhizomes

Plants annual; lemma awns 3 to 8 cm. long; introduced weedy species 1. *E. caput-medusae*.

Plants perennial.

Glumes absent or setaceous and scarcely reaching the first lemma 26. *E. californicus*.

Glumes present and at least half as long as the first lemma.

I. Awns of lemmas curving outward at maturity

Rachis not disarticulating at maturity; internodes of spikes usually 1 cm. long or longer, the spikelets rather distant and distinct from each other; glumes mostly broad, acute or short-awned (occasionally long-awned in *E. arizonicus*).

Spikes with mostly 2 or 3 spikelets at a node 12b. *E. glaucus* subsp. *Jepsonii*.

Spikes with mostly 1 spikelet at a node.

Culms erect at base, usually 40 cm. long or longer; blades, at least some, longer than 10 cm.

Culms slender; blades narrow, usually involute; spikes erect; spikelets usually closely appressed; awns slender, sharply divergent ..

2. *E. spicatus*.

Culms stout; blades 4 to 6 mm. or more broad, flat; spikes flexuous; spikelets usually spreading; awns stout, not sharply divergent ..

3. *E. arizonicus*.

Culms usually decumbent at base, mostly 15 to 35 cm. long; blades usually flat and short, 10 cm. or less long, mostly tufted at base of culms ..

4. *E. sierrus*.

Rachis readily disarticulating at maturity; internodes of spike usually 4 to 6 or 8 mm. long, the spikelets closely imbricated and rather crowded; glumes narrow, attenuate to setaceous, long-awned.

Spikelets mostly 1 at a node ..

5. *E. sariculus*.

Spikelets mostly 2 at a node.

Spikes, including awns, almost as broad as long; glumes bristle-like or cleft into bristle-like divisions, the body scarcely apparent.

6. *E. multisetus*.

Glumes cleft into at least 3 divisions ..

7. *E. elymoides*.

Glumes entire or 2-cleft ..

Spikes much longer than broad; glumes lanceolate, the body apparent ..

8. *E. Hansenii*.

II. Awns of the lemmas straight or undulate, not curving outward at maturity

Spikelets mostly 1 at a node.

Rachis readily disarticulating at maturity; glumes mostly attenuate, with awns 4 to 10 mm. long ..

9. *E. Saundersii*.

Rachis not readily disarticulating; glumes acute or abruptly short-awned, the awns seldom over 4 mm. long.

Spikes relatively dense, the spikelets overlapping $\frac{1}{2}$ to $\frac{3}{4}$ their length; rachis internodes mostly 4 to 8 mm. long ..

13a. *E. pauciflorus*
subsp. *subsecundus*

Spikes not dense, spikelets overlapping the one above on the opposite side of the rachis $\frac{1}{4}$ or less of their length; rachis internodes averaging 10 mm. or more long.

Culm nodes glabrous; lemmas usually long-awned; florets 3 to 5 per spikelet ..

13b. *E. pauciflorus*

Culm nodes finely pubescent; lemmas short-awned; florets mostly 6 to 8 per spikelet ..

subsp. *laeve*.

14. *E. Stebbinsii*.

Spikelets mostly 2 at a node.

Rachis not disarticulating at maturity; glumes usually broadly lanceolate, 3 to 5 nerved; culms usually in small clusters; common in California ..

12. *E. glaucus*.

Rachis disarticulating at maturity; glumes narrowly lanceolate or subulate, 1 to 3 nerved; culms usually in dense clumps; rare or infrequent in California.

Spikes slender, about 5 mm. broad, dense, the spikelets small, closely placed; lemmas 6 to 8 mm. long excluding the awns; glumes lanceolate, 1 to 3 nerved ..

11. *E. Macounii*.

- Spikes stouter, mostly 8 to 10 mm. or more broad;
 lemmas 8 to 10 mm. long.
 Glume with awn mostly 1 to 1.5 cm. long; spikes
 usually 8 cm. or less long 10. *E. aristatus*.
 Glume with awn mostly 2.5 cm. long or longer;
 spikes usually more than 8 cm. long 8. *E. Hansenii*.

AA. Lemmas awnless or with awns 6 mm. or less long

- Glumes broadly lanceolate, strongly 3 to 9 nerved,
 thin, or if thickened then the apex obtuse.
 Plants without rhizomes.
 Spikelets mostly 1 at a node.
 Culm nodes glabrous; florets 3 to 5 per spikelet .. 13. *E. pauciflorus*
 Culm nodes pubescent; florets mostly 6 to 8 per
 spikelet 14. *E. Stebbinsii*.
 Spikelets mostly 2 at a node 12a. *E. glaucus*
 subsp. *virescens*.
 Plants with rhizomes.
 Spikelets mostly 1 at a node.
 Culm internodes 1 to 3 cm. long; rachis disar-
 ticulating at maturity; seashore 15. *E. multinodus*.
 Culm internodes mostly more than 4 cm. long;
 rachis not disarticulating.
 Lemmas glabrous or scabrous.
 Blades flat, thin and lax, bright green,
 rarely glaucous 18. *E. repens*.
 Blades usually involute, stiff, mostly glau-
 cous 20. *E. riparius*
 Lemmas finely pubescent 19. *E. subvillosus*.
 Spikelets mostly 2 at a node 16. *E. mollis*.
 Glumes subulate, or if lanceolate then inconspicuously
 nerved, hard or tough in texture, and awn-tipped
 or acute.
 Spikelets mostly 2 to many at a node.
 Culms finely pubescent below the spike; glumes
 lanceolate; plants rhizomatous; seashore 17. *E. vancouverensis*.
 Culms glabrous below the inflorescence; glumes
 subulate or narrowly lanceolate.
 Spikelets 6 to 40 per node of the rachis includ-
 ing those on branches; culms usually 6 to
 10 mm. in diameter at base; blades 15 to 35
 cm. broad; coastal 24. *E. condensatus*.
 Spikelets 1 to 6 at a node, rarely more; culms
 usually less than 6 mm. in diameter; blades
 3 to 15 mm. broad.
 Culm nodes or vicinity of nodes with fine,
 usually dense pubescence; plants typi-
 cally non-rhizomatous 23. *E. cinereus*.
 Culm nodes glabrous; plants rhizomatous.
 Blades mostly 3 to 6 mm. broad; spikes
 with 1 or 2, occasionally 3, spikelets at
 a node; spikelets 8 to 15 mm. long with
 3 to 6 florets 22. *E. triticoides*.
 Blades mostly 6 to 15 mm. broad; at least
 some nodes of the spike with 3 to 6
 spikelets, or spikelets 17 to 25 mm. long
 and with 6 to 9 florets 22a. *E. triticoides*
 subsp. *multiflorus*.

Spikelets mostly 1 at a node.

Culms mostly 25 to 80 cm. long; spikes well exserted.

Glumes narrow, usually awn-like; florets usually twisted so that the back of the lower lemma is centered between the glumes 22. *E. triticoides*.

Glumes narrowly lanceolate but mostly broader than in *E. triticoides*; lowermost lemma of spikelet lateral to the rachis, the back not centered between the glumes 21. *E. Smithii*.

Culms 10 to 20 cm. long; spikes little exserted, often exceeded by the blades; seashore 25. *E. pacificus*.

The following species of *Elymus* occur in California.

1. *ELYMUS CAPUT-MEDUSAE* L. Sp. Pl. 84. 1753.

2. *Elymus spicatus* (Pursh) comb. nov. *Festuca spicata* Pursh, Fl. Am. Sept. 83. 1814. *Agropyron spicatum* Scribn. & Smith, Bull. U. S. Div. Agrost. 4: 33. 1897.

3. *Elymus arizonicus* (Scribn. & Smith) comb. nov. *Agropyron arizonicum* Scribn. & Smith, Bull. U. S. Div. Agrost. 4: 27. 1897. *A. spicatum* var. *arizonicum* M. E. Jones, Contr. West. Bot. 14: 19. 1912.

4. *Elymus sierrus* nom. nov. *Agropyron Gmelini* var. *Pringlei* Scribn. & Smith, Bull. U. S. Div. Agrost. 4: 31. 1897. *A. Pringlei* Hitchcock ex Jepson, Fl. Calif. 1: 183. 1912. Not *Elymus Pringlei* Scribn. & Merr., 1901.

5. *ELYMUS SAXICOLUS* Scribn. & Smith, Bull. U. S. Div. Agrost. 11: 56. 1898. *Sitanion flexuosum* Piper, Erythea 7: 99. 1899. *S. lanceolatum* J. G. Smith, Bull. U. S. Div. Agrost. 18: 20. 1899. *Agropyron saxicola* Piper, Contr. U. S. Nat. Herb. 11: 148. 1906.

6. *ELYMUS MULTISETUS* (J. G. Smith) Davy, Univ. Calif. Publ. Bot. 1: 57. 1902. *Sitanion jubatum* J. G. Smith, Bull. U. S. Div. Agrost. 18: 10. 1899. Not *Elymus jubatus* Link, 1827. *Sitanion multisetum* J. G. Smith, Bull. U. S. Div. Agrost. 18: 11. 1899.

7. *ELYMUS ELYMOIDES* (Raf.) Swezey, Nebr. Pl. 15. 1891. *Aegilops Hystrix* Nutt., Gen. Pl. 1: 86. 1818. Not *Elymus Hystrix* L. 1753. *Sitanion elymoides* Raf., Jour. Phys. 89: 103. 1819. *Elymus Sitanion* Schult., Mant. 2: 426. 1824. *Sitanion Hystrix* J. G. Smith, Bull. U. S. Div. Agrost. 18: 15, pl. 2. 1899.

8. *ELYMUS HANSENII* Scribn., Bull. U. S. Div. Agrost. 11: 56, fig. 12. 1898. *Sitanion Hansenii* J. G. Smith, Bull. U. S. Div. Agrost. 18: 20. 1899.

9. *ELYMUS SAUNDERSII* Vasey, Bull. Torrey Bot. Club 11: 126. 1884. *Agropyron Saundersii* Hitchcock, Proc. Biol. Soc. Wash. 41: 159. 1928. *Elymus Saundersii* var. *californicus* Hoover, Leaf. West. Bot. 3: 254. 1943.

10. *ELYMUS ARISTATUS* Merrill, *Rhodora* 4: 147. 1902. *E. glaucus aristatus* Hitchcock ex Abrams, *Illus. Fl. Pacific States* 1: 252. 1923.

11. *ELYMUS MACOUNII* Vasey, *Bull. Torrey Bot. Club* 13: 119. 1886. *Terellia Macounii* Lunell, *Am. Midl. Nat.* 4: 228. 1915.

12. *ELYMUS GLAUCUS* Buckley, *Proc. Acad. Nat. Sci. Phila.* 1862: 99. 1862. *Clinelymus glaucus* Nevski, *Bull. Jard. Bot. Acad. Sci. U. R. S. S.* 30: 648. 1932.

12a. *E. GLAUCUS* Buckley subsp. *virescens* (Piper) comb. nov. *E. virescens* Piper, *Erythea* 7: 101. 1899.

12b. *E. GLAUCUS* Buckley subsp. *Jepsonii* (Davy) comb. nov. *E. glaucus* var. *Jepsonii* Davy ex Jepson, *Fl. West. Mid. Calif.* 79. 1901. *E. glaucus* f. *Jepsonii* St. John, *Fl. S. E. Wash. & Adj. Idaho* 42. 1937.

13. *Elymus pauciflorus* (Schwein.) comb. nov. *Triticum pauciflorum* Schwein., in Keating, *Narr. Exped. Winnipeg* 2: 383. 1824. *T. trachycaulum* Link, *Hort. Berol.* 2: 189. 1833. *Agropyron tenerum* Vasey, *Bot. Gaz.* 10: 258. 1885. *A. pauciflorum* Hitchcock, *Am. Jour. Bot.* 21: 132. 1934.

13a. *E. PAUCIFLORUS* (Schwein.) Gould subsp. *subsecundus* (Link) comb. nov. *Triticum subsecundus* Link, *Hort. Berol.* 2: 190. 1833. *T. Richardsoni* Schrad. *Linnaea* 12: 467. 1838. *Agropyron subsecundum* Hitchcock, *Am. Jour. Bot.* 21: 131. 1934.

13b. *E. PAUCIFLORUS* (Schwein.) Gould subsp. *laeve* (Scribn. & Smith) comb. nov. *Agropyron Parishii* Scribn. & Smith var. *laeve* Scribn. Smith, *Bull. U. S. Div. Agrost.* 4: 28. 1897. *A. laeve* Hitchcock ex Jepson, *Fl. Calif.* 1: 181. 1912.

14. *Elymus Stebbinsii* nom. nov. *Agropyron Parishii* Scribn. & Smith, *Bull. U. S. Div. Agrost.* 4: 28. 1897. Not *Elymus Parishii* Davy & Merrill, 1902.

This species is named in honor of Dr. G. Ledyard Stebbins, Jr. of the University of California. For the past several years Dr. Stebbins has made cytogenetical investigations of species of the *Hordeae* tribe, and has contributed substantially to our knowledge of phylogenetic relationships in this group. Dr. Stebbins has worked specifically with the *Elymus* complex to which the species named in his honor belongs.

15. *Elymus multinodus* nom. nov. *Triticum junceum* L., *Mant. Pl.* 2: 327. 1771. Not *Elymus junceus* Fisch. 1811. *Agropyron junceum* Beauv., *Ess. Agrost.* 102. 1812.

16. *ELYMUS MOLLIS* Trin. ex Spreng., *Neue Entdeck.* 2: 72. 1821.

17. *ELYMUS VANCOUVERENSIS* Vasey, *Bull. Torrey Bot. Club* 15: 48. 1888.

18. *Elymus repens* (L.) comb. nov. *Triticum repens* L. Sp. Pl. 86. 1753. *Agropyron repens* Beauv., Ess. Agrost. 102. 1812.

19. *Elymus subvillosus* (Hook.) comb. nov. *Triticum repens* var. *dasystachum* Hook. Fl. Bor. Am. 2: 254. 1840. Not *Elymus dasystachys* Trin. ex. Ledeb. 1829. *Triticum repens* var. *subvillosum* Hook. Fl. Bor. Am. 2: 254. 1840. *T. dasystachum* A. Gray, Man. 602. 1848. *Agropyron dasystachum* Scribn., Bull. Torrey Bot. Club 10: 78. 1883.

20. *Elymus riparius* (Scribn. & Smith) comb. nov. *Agropyron riparium* Scribn. & Smith, Bull. U. S. Div. Agrost. 4: 35. 1897. *A. Smithii* var. *riparium* Jones, Contr. West. Bot. 14: 19. 1912.

21. *Elymus Smithii* comb. nov. *Agropyron Smithii* Rydberg, Mem. N. Y. Bot. Gard. 1: 64. 1900.

22. ELYMUS TRITICOIDES Buckley, Proc. Acad. Nat. Sci. Phila. 1862: 99. 1862. *E. Orcuttianus* Vasey, Bot. Gaz. 10: 258. 1885. *E. simplex* Scribn. & Williams, Bull. U. S. Div. Agrost. 11: 57. pl. 17. 1898.

22a. ELYMUS TRITICOIDES Buckley subsp. MULTIFLORUS Gould, Madroño 8: 46. 1945.

23. ELYMUS CINEREUS Scribn. & Merrill, Bull. Torrey Bot. Club 29: 467. 1902. *E. condensatus pubens* Piper, Erythea 7: 101. 1899. *E. condensatus* f. *pubens* St. John, Fl. S. E. Wash. & Adj. Idaho 42. 1897.

24. ELYMUS CONDENSATUS Presl. Rel. Haenk. 1: 265. 1830.

25. *Elymus pacificus* nom. nov. *Agropyron arenicola* Davy ex Jepson, Fl. West. Mid. Calif. 76. 1901. Not *Elymus arenicolus* Scribn. & Smith, 1899.

26. *Elymus californicus* (Bolander) comb. nov. *Gymnostichum californicum* Bolander, Thurber ex Brewer & Wats. Bot. Calif. 2: 327. 1880. *Hystrix californica* Kuntze, Rev. Gen. Pl. 2: 778. 1891. *Asperella californica* Beal, Grasses N. Am. 2: 657. 1896.

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TWO NEW VARIETIES OF *CONDALIA* FROM TEXAS

V. L. CORY

The small pasture, or horse trap, in which the horses are grazed at the Texas Agricultural Experiment Station, Substation No. 14, contains 118 acres. The pasture is at the summit of the Edwards Plateau at an elevation of 2400 feet, and has a surface comparatively level except for the heads of two small drainage courses. A gently rounded, highly calcareous knoll in the south-central portion of the pasture covers several acres and bears an almost pure stand of *Juniperus Pinchoti* Sudw. with a slight admixture of *Quercus Vaseyana* Buckl. Below the knoll on the west occurs a variety of shrubby vegetation; farther on, in the upper part of a little valley, the shrubs give way to grassland. In this shrubby vegetation occur four kinds of *Condalia*, all growing within twenty-five feet of each other, a circumstance which I do not recall having observed elsewhere. One of these forms of *Condalia* occurs as a close colony and appears to merit varietal recognition.

CONDALIA OBOVATA Hook. var. *edwardsiana* var. nov. A specie differt foliis longioribus angustioribusque, spatulatis nec obovatis. This differs from the typical form of the species in its longer and narrower leaves, which are spatulate instead of obovate.

Type. Twenty-nine airline miles northwest of Rocksprings, Edwards County, Texas, altitude approximately 2400 feet, May 27, 1943, *Cory 41784* (Arnold Arboretum, Harvard University).

This variety is markedly different in appearance from other members of the genus in this area because of its greater height and lighter-colored foliage. Even after long and diligent search, I have been unable to find it anywhere save in this single, isolated thicket. It is closely related to the typical phase of the species, which inhabits the Rio Grande Plains of Texas and northern Mexico, but does not reach the Edwards Plateau or even the escarpment area.